

Baker

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January 4, 2002

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, VA 23511-2699

Attn: Mr. Kirk Stevens
Navy Technical Representative
Code EV23-KAS

Re: Contract N62470-95-D-6007
Navy CLEAN, District III
Contract Task Orders (CTO) 0191 and 0219
Marine Corps Base, Camp Lejeune
Sites 86 and 93 Letter Sample Strategy - Final

Dear Mr. Stevens:

This document provides a proposed sample strategy for Sites 86 and 93. The Partnering Team has recognized the need for additional groundwater contaminant plume characterization at each site prior to moving forward with feasibility studies (FS) and to more effectively apply possible remedial actions. The work to be performed at the sites will be conducted under separate CTOs; however, the sample strategies for both sites are similar. Since methodologies are similar they are discussed in one sample strategy document. Additionally, the field investigations will be performed in one mobilization in an effort to minimize cost and maximize field effectiveness.

Site 86

The chlorinated solvent groundwater plume is approximately 1,700-feet long, which is 700 feet longer than previously observed. The investigation conducted in August 2001 discovered groundwater contamination downgradient of well 86-GW32IW. This investigation also identified several data gaps, including incomplete plume delineation, possible multiple source areas, and/or sources other than Site 86. It was recommended that an additional investigation be implemented to address these data gaps. The purpose of the additional investigation at Site 86 is:

- To further delineate the groundwater contaminant plume vertically and horizontally;
- To clarify known hotspot locations, identify and delineate other hotspots (if present), and identify potential source areas associated with these hot spots; and,
- To assist in the evaluation of remedial alternatives (i.e., active remediation of hot spots)

Also, additional permanent monitoring wells will be installed to supplement the Long-Term Monitoring (LTM) well network and include the recently identified downgradient portion of the plume.



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The proposed scope of the additional characterization is based on the following assumptions:

- Shallow groundwater chlorinated solvent contamination has not been observed. Contamination appears highest between 40 and 50-feet below ground surface (bgs).
- Groundwater flow direction has been fairly consistent and relatively uniform over time. Flow is toward to east-northeast.
- Intermediate wells are screened generally from 40 to 65 feet bgs. Deep wells are screened generally from 80 to 90 feet bgs.

It is proposed that the field investigation will consist of the installation of 26 Geoprobe groundwater sample borings (Figure 1).

Five shallow borings will be installed along the sanitary line leading from Building AS504 (a potential source identified by the Navy historian) as shown on Figure 1. Two groundwater grab samples will be collected at each location as follows:

- 10 to 14 feet bgs
- 20 to 24 feet bgs

If contamination is observed, additional samples will be collected at intervals described for the intermediate borings.

Twenty-one intermediate borings will be installed on transects as shown on Figure 1. Initially, three groundwater grab samples will be collected at each location. The depth intervals of these locations is based on the fact that highest observed groundwater contamination is between 40 and 50-feet bgs:

- 30 to 34 feet bgs
- 40 to 44 feet bgs
- 50 to 54 feet bgs

Analysis for volatile organic compounds (VOCs) will be performed on site by a mobile laboratory.

The number and depths of sampling intervals will be evaluated as the field program progresses, and will be adjusted as necessary to provide vertical delineation. For example, samples may be collected between 10 and 20 feet where hot spots are apparent in the 40 to 44 feet bgs interval. Samples may also be collected below 60-feet bgs to provide vertical delineation. Boring spacings may be adjusted and locations may be added as necessary to define hot spots.

The 16 borings aligned on the three transects oriented perpendicular to groundwater flow (plume length) will be installed first. The purpose of these transects is to delineate the plume width and locate the highest concentrations along the plume width (the plume centerline). The fourth transect is oriented

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parallel to the groundwater flow direction along the plume centerline. The purpose of this transect is to evaluate the change in concentration along the groundwater flow path. This is useful for evaluating hot spot locations and natural attenuation conditions. Two additional borings will be located upgradient of Site 86 (west of Building AS541) to observe groundwater conditions between wells 86-MW17IW and 86-MW24IW.

Three permanent monitoring wells will also be installed at the locations shown on Figure 1. These wells will include one intermediate and one deep well cluster (shown as 86-GW33IW and 86-GW33DW on Figure 1), and one intermediate well (shown as 86-GW34IW on Figure 1). The intermediate wells will be screened between 40 and 45-feet bgs and the deep well will be screened between 85 and 90-feet bgs. If other source areas or hot spots encountered, especially along the sanitary line, additional well installation will be required. It is assumed that one shallow and one intermediate monitoring well will be installed. All newly installed wells will be installed using the same materials and techniques as those used during the remedial investigation (RI).

The findings from this additional plume characterization will be incorporated directly into the amended RI report as scoped in Modification 1 of CTO-0191. The amended RI information will be used to support an FS, which is also funded under CTO-0191.

Site 93

The Partnering Team (November 2001 meeting) decided that additional sampling at Site 93 would be appropriate. The purpose of the sampling is twofold:

1. To further delineate the horizontal and vertical extent of groundwater contamination at Site 93; and,
2. To assist in locating additional permanent monitoring wells, which will be used to supplement the LTM well network.

The data collected from this additional field investigation would be used to complete an FS and support the Interim Record of Decision (IROD).

The proposed scope of the additional investigation is based on the following assumptions:

- Groundwater flow direction is generally to the east, toward Edwards Creek and consistent over time. Figure 2 shows groundwater flow as interpreted in the RI (June 1998) and LTM (April 1999).
- The depth to groundwater ranges from 3 to 5 bgs.
- Shallow wells are screened generally from 4 to 14 feet bgs. Intermediate wells are screened generally from 45 to 50 feet bgs.

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- Groundwater contamination is shallow with the highest concentrations observed in the vicinity of the former UST (Figure 2). Trace levels of VOCs (i.e., below NCWQS) were detected in wells screened at 45 to 50 feet bgs. Total VOCs were observed at 503 µg/L in well UST-MW2 during the 1995 UST investigation⁽¹⁾.
- Contamination observed in wells 93-TW06 and 93-TW07 likely is related to an upgradient source and not Site 93. These wells are located hydraulically upgradient of the former UST, but downgradient of the barracks area. Figure 2 shows the results of the barracks investigation showed that PCE was detected in groundwater at 17 µg/L⁽²⁾.

It is proposed that the field investigation will consist of the installation of 30 Geoprobe groundwater sample borings plus eight alternate/additional locations (Figure 3). Initially, three groundwater grab samples will be collected at each location. Analysis for VOCs will be performed on site by a mobile laboratory. The depth intervals of these locations is based on the fact that groundwater contamination is shallow:

- 5 to 9 feet bgs
- 15 to 19 feet bgs
- 25 to 29 feet bgs

The number of samples and depth intervals will be evaluated as the field program progresses, and will be adjusted as necessary to provide vertical delineation.

The investigation will be conducted in two parts. The first part will focus on the former UST and the area hydraulically downgradient to find hot spots, delineate plume width, identify downgradient extent, and assess the vertical extent. The second part will focus on the area upgradient of the former UST to delineate the vertical and horizontal extent of contamination in the vicinity of the Barracks area.

Borings in the former UST area will be generally spaced at 100 feet. This is based on the distance between 93-TW01 and 93-MW02. Total VOC concentrations dropped from 288 µg/L at well 93-TW01 to 3J µg/L at well 93-MW02. This spacing and the total number of borings will be evaluated as the field program progresses and will be adjusted as necessary to provide adequate delineation.

The borings that are aligned on the transects, labeled "Line 1", "Line 3", and "Line 5" on Figure 3, will be installed first. The purpose of these transects is to further delineate the plume width and locate the highest concentrations along the plume width (the plume centerline). The borings that are on the lines labeled "Line 2" and "Line 4" on Figure 3 will be installed next. These borings, along with the initial transect borings will be used to locate hot spot(s) in the vicinity of the former UST. Once the hot spot(s) and plume centerline have been identified, the borings along the transect labeled "Line 6" on Figure 3 will be installed. The purpose of these borings is to observe to change in concentration (from the former UST area) along the groundwater flow path, and to find the leading edge of the plume. It should be noted that the location of "Line 6" might vary from what is depicted on Figure 3 based on the location of hot spot(s). The borings along the transect labeled "Line 8" on figure 3 will be installed last to identify the thickness of the western end of the plume. Any significant changes in the field plan will be discussed with

⁽¹⁾ Five Well Site Check Marine Corps Base, Camp Lejeune, North Carolina UST TC-942. R. E. Wright Environmental, Inc. June 1995.

⁽²⁾ Contamination Issues P-630 Bachelor Enlisted Quarters – Camp Geiger Jacksonville, NC. Geo Environmental Resources. September 1996.

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LANTDIV prior to initiating those changes. Soil core samples will be collected at 3 or 4 of the proposed boring locations for stratigraphy characterization in the hot spot area(s) to support evaluation of remedial alternatives. The number of stratigraphy characterization borings and locations will be determined in the field.

Four borings will be located in the vicinity of the barracks area as shown on Figure 3. The locations are subject to change as the field program progresses to adequately delineate contamination hydraulically upgradient of the former UST area.

Four permanent wells will be installed as shown on Figure 3. These wells will be installed using Geoprobe Pre-pack screens (10-foot long) and direct push methods. These wells will be developed prior to sampling.

The purpose of these wells is to provide additional LTM data regarding concentrations upgradient of the plume, within plume the hot spot(s), and downgradient of the plume hot spot(s). The locations may change based on the results of the Geoprobe investigation. As shown on Figure 3, one background well will be installed that will be used to provide background water quality data. One groundwater grab sample will be collected from this location to insure that this location is representative of background conditions. These wells will be screened between 4 and 14-feet bgs and will be installed using the same materials and techniques as those used during the RI.

The findings of the Site 93 additional investigation will be presented in a letter report that will supplement the final focused remedial investigation. This report will be issued to the Partnering Team as draft for review and comment. A final letter report will be issued once comments are received and addressed.

The objective for Site 93 is to enter into an IROD. To meet that objective, the draft FS issued in 1997 will be revised based on the latest information obtained from this additional investigation.

Groundwater Analysis and Other Information

Chemical analysis performed on groundwater samples collected from Sites 86 and 93 and will include the following VOCs:

- Tetrachloroethene
- Trichloroethene
- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Vinyl chloride
- Benzene

The above analyses will be performed using an on-site mobile laboratory using the headspace method.

Additional samples will be collected for analyses to support the FS. Given general site conditions, contaminants present, and their concentrations, a list of general dissolved-phase plume remedial technologies was developed. These potential technologies include in-situ chemical destruction (e.g., HRC and potassium permanganate), air sparging, and bio sparging. A list of potential analyses to support design would include:

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- Groundwater and aquifer chemical composition, including primary contaminants, secondary chemical composition, and total organic carbon (TOC) content;
- Site stratigraphy;
- Hydraulic conductivity; and,
- Water quality parameters (WQP), including pH, specific conductance, temperature, oxidation-reduction potential, ferrous iron, alkalinity, and dissolved oxygen.

VOCs the primary contaminant at both sites will be analyzed by mobile laboratory and fixed-base laboratory. Additionally, historical VOC trends are available in the LTM data. Secondary groundwater chemical composition will be assessed through the collection of one target analyte list (TAL) metals sample at each site. These samples will be collected from hot spot wells. These samples will be collected during the first LTM event after completion of new permanent monitoring wells and analyzed in a fixed-base laboratory.

Soil samples for TOC will be collected at two select locations at each site. These analyses will be performed in a fixed-base laboratory.

The site stratigraphy has been characterized in the RI and in subsequent investigations at both sites. Additional stratigraphy characterization will be performed in hot spot areas through soil sample collection and visual logging. This will be performed in conjunction with monitoring well installation. In-situ hydraulic conductivity (slug) tests will also be conducted at wells located within hot spot areas.

The water quality parameters and natural attenuation will be measured in the field from the Geoprobe groundwater samples and the first LTM event after completion of new permanent monitoring wells.

A sampling quality assurance/quality control sampling (QA/QC) program will also be implemented at both sites, and will include the following elements:

- Daily equipment rinsates (analysis for VOCs in the on-site mobile laboratory).
- 10% groundwater sample split for mobile laboratory confirmation by fixed-base laboratory. These splits will be selected from samples over a broad range of contaminant concentrations.

All boring locations at both sites will be cleared for utilities prior to installation, and will be surveyed after installation. One Baker representative will oversee all field activities including utility clearance, drilling, groundwater sampling, and surveying.

All drilling and sampling activities will conform to USEPA Region IV Standard Operating Procedures (SOPs), which are commonly in use at MCB, Camp Lejeune. Health and safety procedures will be in accordance with the original RI project plans.

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Please do not hesitate to call me if you have any questions or desire further clarification of the investigation described. We appreciate the opportunity to serve you in this matter.

Sincerely,

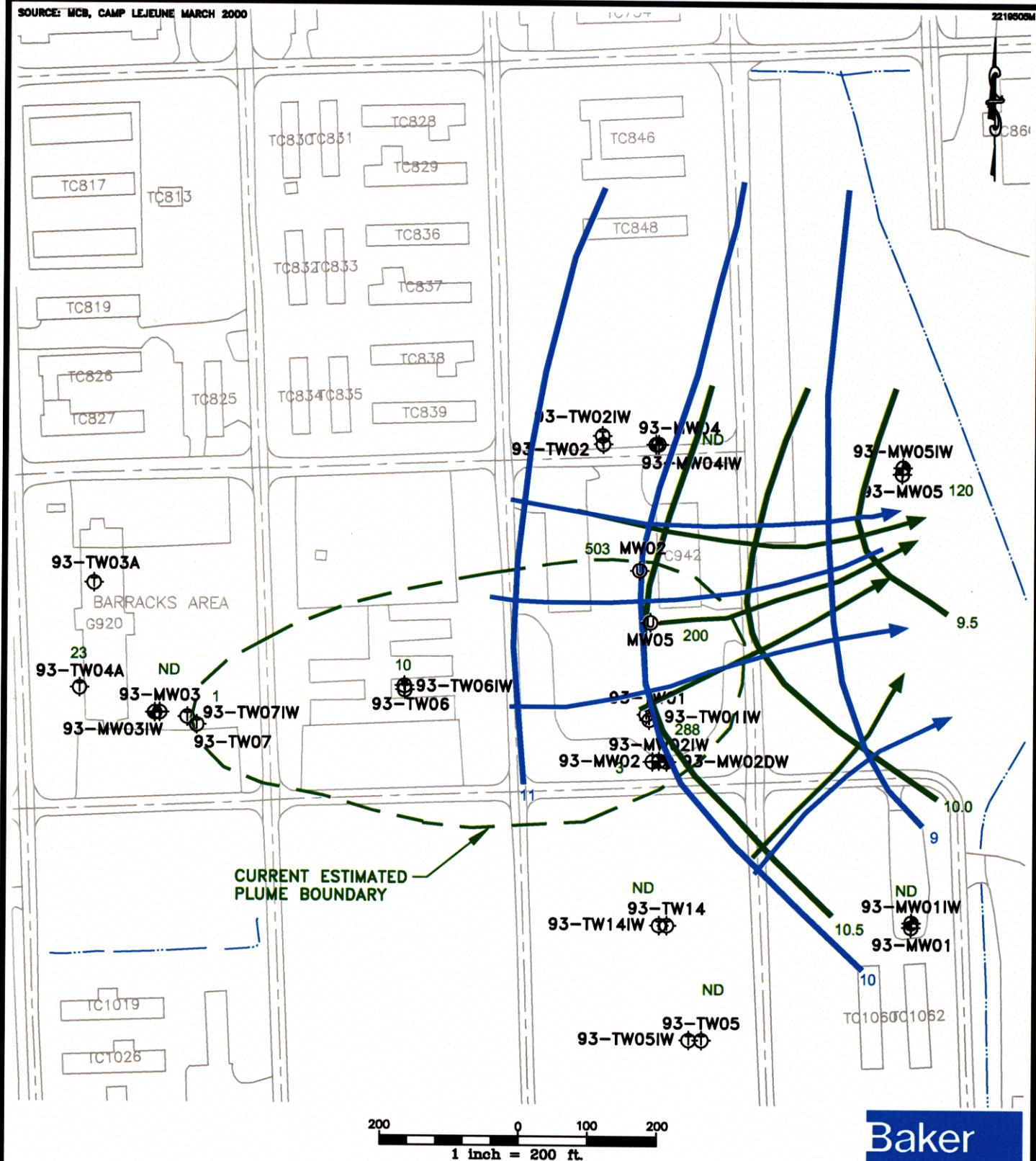
BAKER ENVIRONMENTAL, INC.



Mark K. DeJohn, P.G.
Project Geologist

MKD/lp
Attachment

cc: Mr. Channing Blackwell, LANTDIV (w/attachment)
Mr. Scott Bailey, CH2M Hill (w/attachment)
Mr. Christopher Bozzini, CH2M Hill (w/attachment)
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Ms. Diane Rossi, NC DENR - WRO (w/attachment)
Dr. Charlie Stehman, NC DENR - WRO (w/attachment)
Mr. Jim Dunn, IT Group (w/attachment)

**LEGEND**

- ⊕ - SHALLOW GROUNDWATER MONITORING WELL (IR PROGRAM)
- ⊕ - TEMPORARY SHALLOW WELL
- ⊕ - SHALLOW GROUNDWATER MONITORING WELL (UST PROGRAM)
- 503 - TOTAL VOC CONCENTRATION (ug/L)
- - GROUNDWATER FLOW DIRECTION (RI)
- - GROUNDWATER FLOW DIRECTION (LTM)
- - GROUNDWATER CONTOUR (RI)
- - GROUNDWATER CONTOUR (LTM)

FIGURE 2
SITE CONDITIONS
OPERABLE UNIT NO. 16 - SITE 93
MONITORING AND O&M SUPPORT
CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



93-MW01

- SHALLOW GROUNDWATER MONITORING WELL (IR PROGRAM)
- PROPOSED WELL LOCATION
- PROPOSED BORING LOCATION
- PROPOSED ALTERNATE/ADDITIONAL BORING LOCATION
- SHALLOW GROUNDWATER MONITORING WELL (UST PROGRAM)

FIGURE 3
PROPOSED BORING AND WELL LOCATIONS
OPERABLE UNIT NO. 16 - SITE 93
MONITORING AND O&M SUPPORT
CTO - 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA